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THE ADAPTIVENESS OF NATURE.

BY GRANT ALLEN.

It was a favorite point of poor Hugh Miller's, in the days just before the evolutionist philosophy came, like a flood, to overthrow his crude and half-digested cosmical system, that fruits and grains first appeared upon the earth in any numbers on the very eve of the advent of man, late on in the course of the Tertiary period. It seemed to Miller, as to many of his contemporaries, that edible fruits were created beforehand for that very purpose—set there, in short, as the English church-service naïvely words it, "so as in due time we might enjoy the same." Nature thus appeared to make herself ready in anticipation for that final flower and head of creation, man, who was to become thereafter her lord and master.

How far we have left those ideas behind! We know nowadays that such a conception as this is biologically faulty; that every part of every organism has prime reference only to that organism's own internal heads, without reference to any one else's convenience in any way. But there is, nevertheless, a certain sense in which this curious premature generalization throws real light both on the origin of fruits and grains, and on the origin of man and the higher monkeys. While it is *not* true that fruits were developed beforehand in order that in the fullness of time man might pick and eat them, it *is* quite true that for man and the apes they were really developed, and that without them man and the apes could never even have begun to exist. They were mutually necessary. The evolution of the two went on collaterally, and each involved the simultaneous existence and evolution of the other.

The great grain-producing and fruit-bearing families of plants, and the apes, monkeys, and progenitors of man, first appear, geologically speaking, in the Tertiary period. Now, the distinctive mark of the monkeys, as a group, is the possession of hands, and the hand, in turn, points them out as essentially arboreal and fruit-eating animals. It is true that some of the quadrumana—man in particular, as well as the baboons, chimpanzees, and gorillas—have taken at last to a more or less terrestrial existence ; but the hand as a hand could never have been first developed under terrestrial conditions ; it needed for its original evolution a forestine life, though, when once acquired, it would easily be employed for purposes far different from those which gave it rise at the outset. All the most forestine animals on earth—the marsupial opposums themselves included—possess in a greater or less degree the opposable thumb, which is the true key-note of the genuine hand ; and even the fruit-eating birds, like the parrots, have independently developed under similar conditions a closely analogous grasping organ.

Arboreal animals possess, as a rule, great agility, power of balance, and muscular flexibility. Practice implies all these qualities, and natural selection, acting by the destruction of the slow or clumsy, still further insures them in an arboreal species. Moreover, tree-haunting animals live generally on very rich and nutritive food-stuffs. If they were mere herbivores of the ordinary grass-eating type, they would thrive better upon the open plains, like buffaloes, deer, wild horses, and zebras. The mere fact that they have taken to the trees for a living in itself almost implies a more nutritive diet ; for tree-haunters live mainly upon seeds and nuts, which are the very rich stores of food laid up by the plant for the nourishment of its own precious seedlings. Even arboreal rodents show us the tendency towards such richer diet in the case of squirrels, dormice, and other climbing species. The arboreal animals are smaller, as a rule, than the terrestrial ruminants, but they are quicker, more intelligent, more varied in their movements, and dependent upon richer and less bulky food.

See the sum of these differences put briefly : on the one hand, the cow, large, heavy, slow of movement, eating grass all day, requiring for its digestion a complicated stomach with its cud-chewing provision, and possessing hoofed toes, flat on the ground, inflexible, insensitive, and ill-adapted for conveying external information to the small brain ; on the other hand, the squirrel, little, lithe, swift, active, feeding upon rich, oily nuts and seeds, possessing sharp claws and prehensile feet, and capable of grasping an object all round in its paw, so as to gain a perfect knowledge of its true shape and its general space relations. In the one case, much food must be digested for little result in variety of movement; in the other case, little food need be digested for much result in building up nerve, brain, and muscle, and in complicated motions of the most diverse descriptions.

Now, of this advanced and agile arboreal type, the monkey race (taken as a whole) is the last term, the highest development. See what it involves. In the first place, it can hardly exist at all except in tropical or sub-tropical forests, where there is energy enough received by the earth from the sun's rays to produce in abundance the rich fruits and seeds in whose presence alone such a race is possible. Then, side by side with the evolution of the race, there must go the parallel evolution of the fruits and seeds, which must also benefit the plants that produce them, or else the producing species will become extinct at the hands of the monkeys. How can these conflicting claims be reconciled ? This was the problem that had to work itself out in the tropical forests of the Tertiary period, and here is the way in which it seemingly worked itself.

Just in proportion as higher types of animals, both birds and mammals, made inroads upon the seeds of the tertiary period must the plants that produced them have responded to the demand by more and more strenuous means of protection. The faster the squirrels, monkeys, and parrots (or their remote progenitors and shadowy representatives) eat up all suitable seeds and fruits, the harder must the seeds endeavor (as it were) to outwit and defeat them. For only those seeds could grow into plants which could escape the close pursuit of the monkeys and parrots. At first sight, it seems as though the only possible result of such a conflict must be the extermination of the seed-eating tree-haunters ; for, on the one hand, if the plant succeeds in repelling them, they must die at once ; and, on the other hand, if the plant fails to repel them, and the seed gets eaten, they must die in the long run by cutting off the only means of reproducing their own supplies for the future. But in actual practice what has happened is this : The plant has turned the fruit-eaters into allies instead of enemies, by converting the outer portion of the fruit into a soft, sweet pulp, though at the same time it covers the actual seed inside with a hard stone like that of the peach, the mango, and the apricot. Sometimes, too, to make assurance doubly sure, it fills the vital kernel with bitter and poisonous juice, as in the pips of the orange, or surrounds them with unpleasant and inedible hairs, as in the centre of the rose hip. The consequence is that the aggressive animal eats the outer pulp, but throws away the valuable seed to germinate and reproduce its like—and his food—in future.

Observe, now, further, how necessary is the coincidence of all these facts for the development of all the higher apes, and especially of man, their ultimate outcome. The large tropical fruits require hands (or something analogous) to pull and eat them. Hence the lemur-like or squirrel-like paw gets developed in true monkeys into the genuine hand, which is used in grasping, picking, and eating the fruit. How needful such a development is for fruit-eaters we see by analogy in the case of the like-minded fruit-eating birds, which either, as in the parrot, have a hand-like foot, or else, failing that, as in the toucans and hornbills, have a large and preposterously developed grasping beak to perform the same office. Even the squirrel holds his nut in his paws; the parrot holds it in one claw, hand-wise; the monkey, the highest and most specialized of all, holds it in a perfect hand, between thumb and fingers.

Furthermore, these tropical fruits and nuts have almost always a thick and disagreeable rind or husk, which must be stripped off and thrown away before the edible pulp or kernel is arrived at. The orange and mango are good cases in point. This disagreeable rind is put there by natural selection in order to repel insects, small rodents, and other useless creatures (from the plant's point of view), which would eat off the pulp on the tree, as wasps eat pears, without doing anything in return to disperse the seeds; but the animal that can pick the fruit can also tear off the rind, and in this act, also, hands or their equivalents come in useful. In all these ways the development of the fruits, and the development of the fruit-eaters, must necessarily have gone on by parallel stages.

We can see, too, if we reflect for a moment, that man could only have been evolved as we now know him through just such a tree-haunting ancestry as this. For, in the first place, man absolutely bases himself upon the possession of a hand, which, first rudely stretched out to grasp the branches of trees, and afterwards further moulded by use in picking and stripping nuts and fruits, can at last be applied to such different uses from those by which it was originally developed. Then, again, the habit of grasping (as Mr. Herbert Spencer has shown) implies a wider conception of the physical properties of things; so that all the most intelligent animals in a state of nature—monkeys, squirrels, elephants, parrots—are those which have a grasping organ. Once more, specially nutritious food allows periods of comparative leisure, during which the faculties can be devoted to other objects, as we see in the restless curiosity of monkeys, in their gambols and antics, and finally in the artistic and industrial energies of man himself. If an animal lives upon grass or leaves, he has to concentrate almost all his vital activity on the mechanical labor of feeding and digesting; if he lives upon richer and more nutritious food, he has organic and muscular leisure in abundance. Man, by still further enriching his food-stuffs, through the deliberate selection and cultivation of fruits and cereals, and through the art of cooking, has allowed himself yet greater leisure for other arts, and so has attained his present preëminence.

But a consideration of his structure shows us conclusively that without the arboreal fruit-eating ancestors from whom he is descended, he could never have become just what he is. His hand is the index of his arboreal origin.

GRANT ALLEN.